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I, Toshiaki Sato, residing at 7 th Fl., Shuwa Kioicho Park Bldg., 3-6, Kioicho, Chiyoda-ku, Tokyo, Japan, hereby declare that I have a thorough knowledge of Japanese and English languages, and that the attached pages contains a correct translations into English of the application documents of Japanese Patent Application Nos. 7-196677 filed on August 1, 1995, 7-205886 filed on August 11, 1995 and 7-214552 filed on August 23, 1995 in the name of CANON KABUSHIKI KAISHA.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statement were made with the knowledge that willful false statements and the like so made, are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 22nd day of March, 2006

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Translation of Japanese Patent Application No. 7-196677

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[Title of the Invention] IMAGE REPRODUCING METHOD AND APPARATUS

[What Is Claimed Is:]

[Claim 1] An image reproducing method characterized by converting image sensing data obtained by image sensing means into a visualizable image signal by using an image reproduction parameter, and comprising forming a group of image sensing data consisting of a plurality of image sensing data meeting a predetermined condition, determining the image reproduction parameter on the basis of the image sensing data group, and converting the image sensing data belonging to the image sensing data group into image data by using the image reproduction parameter.

[Claim 2] The image reproducing method according to claim 1, characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data whose color temperature data fall within a previously designated color temperature data range, the color temperature data being obtained by analyzing the image sensing data.

[Claim 3] The image reproducing method according to claim 1, characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data selected by a user from a group of images which are displayed through simple reproduction of the image sensing data.

[Claim 4] The image reproducing method according to claim 1, characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data in which one of pieces of information appended to the image sensing data, such as a photographing time, an EV value, an aperture value, an object distance, and a shutter speed, or a combination of these pieces of information falls within a previously numerically designated range.

[Claim 5] The image reproducing method according to claim 1, characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data in which one of pieces of information appended to the image sensing data, such as a photographing mode, a photographing place, the use/nonuse of an electronic flash, and the use/nonuse of an optical low-pass filter, or a combination of these pieces of information meets a previously designated condition.

[Claim 6] The image reproducing method according to claim 1, characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data having information appended thereto which indicates that the image sensing data are adapted to form a synthetic image.

[Claim 7] An image reproducing apparatus characterized in that said apparatus converts image sensing data obtained by image sensing means into a visualizable image signal by using an image reproduction parameter, and comprises image sensing data memory means for storing obtained image sensing data, image sensing data selection designating means for designating a condition for image sensing data selection, image sensing data selecting means for selecting image sensing data from said image sensing data memory means, image sensing data holding means for holding the image sensing data selected by said image sensing data selecting means, image reproduction parameter determining means for determining an image reproduction parameter by using the selected image sensing data held by said image sensing data holding means, and image reproduction processing means for performing image reproduction on the basis of the image sensing data held by said image sensing data holding means by using the image reproduction parameter determined by said image reproduction parameter determining means,

wherein a group of image sensing data consisting of a plurality of image sensing data meeting a predetermined condition are formed, the image reproduction parameter is determined on the basis of the group of image sensing data, and the image sensing data belonging to the image sensing data group are converted into image data by using the image reproduction parameter.

[Claim 8] The image reproducing apparatus according to claim 7, characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data whose color temperature data fall within a previously designated color temperature data range, the color temperature data being obtained by analyzing the image sensing data.

[Claim 9] The image reproducing apparatus according to claim 7, characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data selected by a user from a group of images which are displayed through simple reproduction of the image sensing data.

[Claim 10] The image reproducing apparatus according to claim 7, characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data in which one of pieces of information appended to the image sensing data, such as a photographing time, an EV value, an aperture value, an object distance, and a shutter speed, or a combination of these pieces of information falls within a previously numerically designated range.

[Claim 11] The image reproducing apparatus according to claim 7, characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data in which one of pieces of information appended to the image sensing data, such as a photographing mode, a photographing place, the use/nonuse of an electronic flash, and the use/nonuse of an optical low-pass filter, or a combination of these pieces of information meets a previously designated condition.

[Claim 12] The image reproducing apparatus according to claim 7, characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data having information appended thereto which indicates that the image sensing data are adapted to form a synthetic image.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present relates to the technical field of an image reproducing method and apparatus for converting image data of an image sensing signal obtained by an image sensing device such as an image sensing tube or a CCD into a visualizable image signal, e.g., an NTSC-RGB signal or the like.

[0002]

[Prior Art]

In a conventional image reproducing apparatus such as a television camera using an image sensing device such as a CCD, some image reproduction parameters are generally determined from image sensing data during image reproduction processing in which image data are obtained from the image sensing data, in order to constantly obtain images which apparently give the same impression or to obtain as faithful reproduced images as possible regardless of deterioration with time of the image sensing device or a color filter and changes in an illuminating light source. Examples of the image reproduction parameters are a color temperature and a reproduction luminance level. The image reproduction parameters are used to correct the color temperature or set the reproduction luminance level. More specifically, the correction of the color temperature is to adjust a so-called white balance so that an object which is supposed to look white looks white. Generally, this color temperature correction is performed on the basis of image sensing data. That is, image data which is supposed to look white is extracted from image sensing data, and a white balance coefficient as one image reproduction parameter is determined on the basis of the extracted data. In the white balance adjustment, a plurality of color component signals constituting an output image signal from an image sensing device are, respectively, provided with gains and corrected using the white balance coefficient. Consequently, the signal levels of the color components constituting the image signal of the object which is supposed to look white are so adjusted as to be equal to each other.

[0003]

The setting of the reproduction luminance level is done by calculating a luminance distribution from image sensing data and setting an optimum reproduction luminance level (range). The parameter is adjusted such that a reproduced image is obtained within this range, and the image is reproduced.

[0004]

[Problems That the Invention Is to Solve]

The method of adjusting the hue of an image by adjusting the white balance as described above is effective when a sufficient number of objects which are supposed to look white exist in an image signal obtained from an image sensing device. However, no such object which is supposed to look white exists in an image signal or only a very few such objects exist in an image signal in specific instances. In these instances, therefore, it is in principle impossible to adjust the hue by adjusting the white balance. In such instances, the general approach is to average the image signal containing the entire image sensing data of one image plane for each color component and adjust the white balance by using the average, in order to avoid the problem. However, a color indicated by the obtained average is not necessarily white (the color of a light source), and so the white balance cannot be accurately adjusted.

[0005]

Thus, in the conventional image reproducing apparatus, the image reproduction parameter cannot be accurately set if it is determined from image sensing data when image reproduction processing is performed in order to obtain an optimum reproduced image.

[0006]

Also, in the setting of the reproduction luminance level, if the reproduction luminance parameter is determined for each image sensing data, the correlation between the luminances of a plurality of image sensing data is lost when image comparison or image synthesis processing is performed. This makes the comparison of reproduced images difficult, or the connection of luminances becomes unnatural when the reproduced images are synthesized.

[0007]

For example, the above inconveniences are significant when an object which is to be originally, desirably photographed as one image plane is divisionally photographed and image sensing data corresponding to the plurality of image planes are obtained.

[0008]

That is, when a reproduced image is obtained by using an image reproduction parameter determined from image information, an independent image reproduction parameter is obtained for each image sensing data. For this reason, it is impossible to obtain a reproduced image which is used when information between a plurality of images is extracted by comparing and analyzing the images, such as when physical property information is obtained from luminance information.

Also, if the reflectance of an object spatially, gradually changes, individual image sensing data obtained by divisionally photographing the object have different luminance levels (ranges). If images are reproduced by independently optimizing these image sensing data, the correlation between luminances originally corresponding to the respective image sensing areas is lost in the reproduced images. Accordingly, if one image is formed by synthesizing these images taken in the respective image sensing areas, an unnatural synthetic image in which the correlation between luminances is lost results.

[0009]

The present invention has been made to solve the above problems, and has as its object to provide an image reproducing method and apparatus capable of performing desired accurate image reproduction.

[0010]

[Means of Solving the Problems]

In order to achieve the above object, there are provided an image reproducing method and an image reproducing apparatus in accordance with the present invention as follows:

(1) The present invention provides an image reproducing method characterized by converting image sensing data obtained by image sensing means into a

visualizable image signal by using an image reproduction parameter, and comprising forming a group of image sensing data consisting of a plurality of image sensing data meeting a predetermined condition, determining the image reproduction parameter on the basis of the image sensing data group, and converting the image sensing data belonging to the image sensing data group into image data by using the image reproduction parameter.

[0011]

(2) The present invention provides the image reproducing method according to (1), characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data whose color temperature data fall within a previously designated color temperature data range, the color temperature data being obtained by analyzing the image sensing data.

[0012]

(3) The present invention provides the image reproducing method according to (1), characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data selected by a user from a group of images which are displayed

through simple reproduction of the image sensing data.

[0013]

(4) The present invention provides the image reproducing method according to (1), characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data in which one of pieces of information appended to the image sensing data, such as a photographing time, an EV value, an aperture value, an object distance, and a shutter speed, or a combination of these pieces of information falls within a previously numerically designated range.

[0014]

(5) The present invention provides the image reproducing method according to (1), characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data in which one of pieces of information appended to the image sensing data, such as a photographing mode, a photographing place, the use/nonuse of an electronic flash, and the use/nonuse of an optical low-pass filter, or a combination of these pieces of information meets a previously designated condition.

[0015]

(6) The present invention provides an image

reproducing method according to (1), characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data having information appended thereto which indicates that the image sensing data are adapted to form a synthetic image.

[0016]

(7) The present invention provides an image reproducing apparatus characterized in that the apparatus converts image sensing data obtained by image sensing means into a visualizable image signal by using an image reproduction parameter, and comprises image sensing data memory means for storing obtained image sensing data, image sensing data selection designating means for designating a condition for image sensing data selection, image sensing data selecting means for selecting image sensing data from the image sensing data memory means, image sensing data holding means for holding the image sensing data selected by the image sensing data selecting means, image reproduction parameter determining means for determining an image reproduction parameter by using the selected image sensing data held by the image sensing data holding means, and image reproduction processing means for performing image reproduction on the basis of the image

sensing data held by the image sensing data holding means by using the image reproduction parameter determined by the image reproduction parameter determining means,

wherein a group of image sensing data consisting of a plurality of image sensing data meeting a predetermined condition are formed, the image reproduction parameter is determined on the basis of the group of image sensing data, and the image sensing data belonging to the image sensing data group are converted into image data by using the image reproduction parameter.

[0017]

(8) The present invention provides the image reproducing apparatus according to (7), characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data whose color temperature data fall within a previously designated color temperature data range, the color temperature data being obtained by analyzing the image sensing data.

[0018]

(9) The present invention provides the image reproducing apparatus according to (7), characterized in that the group of image sensing data consisting of a

plurality of image sensing data meeting the predetermined condition are image sensing data selected by a user from a group of images which are displayed through simple reproduction of the image sensing data.

[0019]

(10) The present invention provides the image reproducing apparatus according to (7), characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data in which one of pieces of information appended to the image sensing data, such as a photographing time, an EV value, an aperture value, an object distance, and a shutter speed, or a combination of these pieces of information falls within a previously numerically designated range.

[0020]

(11) The present invention provides the image reproducing apparatus according to (7), characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data in which one of pieces of information appended to the image sensing data, such as a photographing mode, a photographing place, the use/nonuse of an electronic flash, and the use/nonuse of an optical low-pass filter, or a combination of these pieces of information meets a

previously designated condition.

[0021]

(12) The present invention provides the image reproducing apparatus according to (7), characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data having information appended thereto which indicates that the image sensing data are adapted to form a synthetic image.

[0022]

The present invention achieves the above-mentioned object with the respective arrangements as described above.

[0023]

[Embodiments]

In order to achieve the above object, according to the present invention, an image reproducing method and apparatus for converting image sensing data obtained by image sensing means into a visualizable image signal by using an image reproduction parameter are characterized in that the image reproduction parameter is determined from a group of image sensing data consisting of a plurality of image sensing data meeting a predetermined condition and the image sensing data belonging to the image sensing data group are converted into image data by using the image reproduction parameter.

[0024]

The image reproducing method and apparatus are further characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data whose color temperature data fall within a previously designated color temperature data range, the color temperature data being obtained by analyzing the image sensing data.

The image reproducing method and apparatus are further characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data selected by a user under a condition that the compositions of an object displayed through simple reproduction of the image sensing data are similar to each other.

[0025]

The image reproducing method and apparatus are further characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data in which one of pieces of information appended to the image sensing data, such as a photographing time, an EV value, an aperture value, an object distance, and a shutter speed, or a combination of these pieces of information falls within a previously numerically designated range.

[0026]

The image reproducing method and apparatus are further characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are image sensing data in which one of pieces of information appended to the image sensing data, such as a photographing mode, a photographing place, the use/nonuse of an electronic flash, and the use/nonuse of an optical low-pass filter, or a combination of these pieces of information meets a previously designated condition.

[0027]

Furthermore, the image reproducing method and apparatus are characterized in that the group of image sensing data consisting of a plurality of image sensing data meeting the predetermined condition are a plurality of image sensing data having information as image sensing data adapted to form a synthetic image or a plurality of image sensing data selected as image sensing data adapted to form a synthetic image.

[0028]

According to the above-described image reproducing method and apparatus, image sensing data of a plurality of image planes associated to each other are processed as a group of image sensing data and an optimum image reproduction parameter is determined by using the image sensing data. The image sensing data constituting the image sensing data group are converted into image data by using the image reproduction parameter.

[0029]

[Embodiment]

An embodiment of the present invention will be described below with reference to the accompanying drawings.

[0030]

Fig. 1 is a block diagram showing an embodiment of an image reproducing apparatus according to the present invention.

[0031]

Reference numeral 10 denotes a color image sensing unit, such as a digital camera, which senses the image of an object and outputs the image data of the object to an image sensing data memory 20 as two-dimensional digital image sensing data (hereinafter referred to simply as "image sensing data"). The image sensing data memory 20 stores and holds the image sensing data supplied from the color image sensing unit 10.

[0032]

A color image reproduction processor 30 performs predetermined image reproduction processing for the image sensing data stored and held in the image sensing data memory 20. For example, the color image reproduction processor 30 converts the image sensing data into digital NTSC-RGB data and outputs the digital data to a color image reproducing display 40 and a reproduced image data memory 50.

[0033]

The color image reproducing display 40 includes a color video card and a monitor, for example. The color image reproducing display 40 receives an output color image signal from the color image reproduction processor 30 or reads out a color image signal from the reproduced image data memory 50 and displays the signal as a color image on the monitor.

[0034]

The reproduced image data memory 50 stores the image data reproduced by the color image reproduction processor 30. The image data stored in the reproduced image data memory 50 is supplied to and displayed by the color image reproducing display 40 as needed.

[0035]

More specifically, the color image reproduction processor 30 comprises an image sensing data holding mechanism 31 for holding the digital image sensing data from the image sensing data memory 20, an image sensing data selecting mechanism 33 for selecting image sensing data from the image sensing data memory 20 and outputting the selected data to the image sensing data holding mechanism 31, an image sensing data selection designating unit (designating means) 34 for designating the condition or the like by which the image sensing data selecting unit 33 selects image sensing data, an image reproduction processing unit 35 for reproducing an image of the image sensing data held by the image sensing data holding unit 31 by using an image reproduction parameter determined by an image reproduction parameter determining unit 32 adapted to determine the image reproduction parameter by using the image sensing data held by the image sensing data holding unit 31, and a control unit 36 for controlling these units of the color image reproduction processor 30.

[0036]

Examples of the image reproduction parameter determined by the image reproduction parameter determining unit 32 are parameters indicating a color temperature, a white balance coefficient, a color component gain, white point information, black point information, a gamma coefficient, a gradation characteristic, a gradation conversion curve, a gradation conversion lookup table, a knee point, a dynamic range, a color gamut, light source information, a color coordinate conversion matrix coefficient, a spatial frequency characteristic, a black balance coefficient, an S/N ratio, an auto-correlation coefficient, a Wiener spectrum, an intensity (density) distribution, and a luminance distribution, and parameters obtained directly or indirectly from these pieces of information.

[0037]

The image sensing data selection designating unit 34 can designate the condition of selection in order that of a plurality of image sensing data stored in the image sensing data memory 20, image sensing data meeting a predetermined condition be processed as a group of image sensing data. The designated condition is given, e.g., as a condition related to color temperature information or the composition of an object obtained from image sensing data, or as a predetermined condition pertaining to the photographing time, the photographing mode, the photographing place, the EV value, the aperture value, the object distance, the shutter speed, the use/nonuse of an electronic flash, or the use/nonuse of an optical low-pass filter, each of which is information appended to image sensing data.

[0038]

Fig.12 is a flow chart showing the procedure of image processing done by the image reproducing apparatus of this embodiment. This program is executed by the color image reproduction processor 30. Assume that a plurality of image sensing data obtained by the color image sensing unit 10 are already stored in the image sensing data memory 20.

[0039]

When the flow chart shown in Fig.12 starts, the control unit 36 for performing the processing first checks the contents of image sensing data selection designated (in step S1) by the image sensing data selection designating unit 34 and sends the contents of the designated selection to the image sensing data selecting unit 33. Then, on the basis of the contents of the selection designated by the image sensing data selection designating unit 34, the image sensing data selecting unit 33 selects image sensing data meeting the contents of the designated selection from the image sensing data stored in the image sensing data memory 20 and outputs the selected data to the image sensing data holding unit 31 (S2). If the image sensing data meeting the contents of the designated selection is data of less than one image plane, this program is not executed. If the selected image sensing data is data of one image plane, the image sensing data is converted into image data by ordinary image reproduction processing. If there is no image sensing data to be selected, information indicating this is output, and the processing is terminated.

[0040]

The image sensing data holding unit 31 temporarily holds the image sensing data selectively output from the image sensing data memory 20 (S3).

[0041]

The image reproduction parameter determining unit 32 analyzes the image sensing data temporarily held by the image sensing data holding unit 31 using the image sensing data, obtains, e.g., light source information (e.g., the color temperature or the chromaticity of the light source) when the image sensing data are obtained, which is necessary in white balance adjustment, and determines an image reproduction parameter on the basis of the light source information (S4). That is, by using the plurality of image sensing data selected and held as a group of image sensing data, the image reproduction parameter determining unit 32 determines an image reproduction parameter and sends the parameter to the image reproduction processing mechanism 35.

[0042]

By using the image reproduction parameter thus determined, the image reproduction processing unit 35 converts the image sensing data constituting of the image sensing data group held by the image sensing data holding unit 31 into image data (S5).

[0043]

The conditions under which image sensing data are selected from a plurality of image sensing data so as to be processed as one group of image sensing data will be described below.

[0044]

Information obtained from the analysis of image sensing data itself includes color temperature information and the composition of an object. It is sometimes necessary to process a plurality of image sensing data whose color temperatures are within a certain fixed range as a group of correlated image sensing data. Especially when the number of samples used to estimate color temperatures is small, the estimation accuracy can be increased by again estimating the color temperatures by using a plurality of image sensing data whose estimated color temperatures are within a certain fixed range. Consequently, image reproduction can be performed with a high accuracy.

[0045]

If the compositions of objects are the same or very similar, there is a high possibility that the objects were photographed under the same photographing condition. Accordingly, the image reproduction parameters of the images are the same or can be processed as the same parameter within a certain fixed range of accuracy. If this is the case, an image reproduction parameter can be accurately obtained when it is obtained from a plurality of image sensing data. It is in many instances useful to process image sensing data having the same object composition or similar object compositions as a group of image sensing data.

[0046]

Examples of information useful to find the correlation between image sensing data are, e.g., the photographing time (date), the photographing mode, the photographing place, the EV value, the shutter speed, the aperture value, the object distance, the use/nonuse of an electronic flash, and the use/nonuse of an optical low-pass filter. If these pieces of information are given as information appended to image sensing data, a group of image sensing data can be generated by analyzing these pieces of information.

[0047]

For example, if the photographing times of image sensing data are within a certain fixed range, it is obviously effective to process these data as a group of image sensing data. It is also clearly effective to process a series of image sensing data whose imaging mode is a continuous shooting mode as a group of image sensing data. As for information pertaining to the use/nonuse of an electronic flash, information of the photographing light source largely depends upon the characteristics of the flash light. Therefore, it is useful to simultaneously process a plurality of image sensing data, obtained by using an electronic flash, as a group of image sensing data.

[0048]

Pieces of information such as the EV value, the shutter speed, the aperture value, and the object distance extremely largely depend upon the photographing conditions and function as strong restricting conditions when a reproduction parameter is determined. Therefore, image sensing data having these values within a predetermined range are processed as one image sensing data group. This is very efficient when image reproduction is performed.

[0049]

In information of the photographing place, the characteristics of object remain unchanged. Therefore, this information is very effective in accurately reproducing an object. Additionally, when this information is used in combination with information of, e.g., the photographing time (date), information on a change in the photographing conditions can also be obtained. This obviously increases the usefulness of the information of the photographing place.

[0050]

In the above example, the condition for each individual information is primarily described. However, it is evident that the effectiveness is sometimes greatly improved by combining the above conditions.

[0051]

As shown in Fig. 3, for example, as the condition of processing, a plurality of image sensing data having a spatial continuity are sometimes designated to obtain a synthetic image. If this is the case, it is necessary to hold the spatial continuity in the synthetic image. For this purpose, it is very effective to perform image reproduction processing by processing the above-described plurality of image sensing data as one group of image sensing data.

[0052]

Also, as illustrated in Fig.†4, if it can be determined from the photographing place information or composition information obtained by analyzing image sensing data that the image sensing data have a time continuity and are obtained from objects which are nearly the same, a reproduced image maintaining the time continuity can be obtained by processing these image sensing data as one group of image sensing data using the image reproducing method and apparatus according to the present invention.

[0053]

If these image sensing data are obtained outdoors, for example, an image can be reproduced while a continuous change with a change in the photographing time, i.e., the condition of sunshine, is held. More specifically, a reproduced image having a time continuity can be obtained by continuously changing an image reproduction parameter of image sensing data of an image sensing data group consisting of a plurality of image sensing data obtained from objects which are almost the same. This allows reproduction of an image while correcting disturbance occurring in some image sensing data due to a sudden change in the conditions. As a consequence, a temporally natural image can be obtained.

[0054]

Also, as shown in Fig. 5, image sensing data having both a time continuity and a continuity in the photographing order, i.e., image sensing data obtained when the photographing mode is a continuous shooting mode, or image sensing data also having a spatial continuity, are processed as one group of image sensing data. Consequently, an extraneous condition occurring in each individual image sensing data can be eliminated, and this allows reproduction of an image keeping the continuity.

[0055]

A method of grouping image sensing data, i.e., a method of obtaining a group of image sensing data, by using color temperature information obtained from the analysis of the image sensing data itself will be described in detail below. Fig. 6 is a flow chart showing the image sensing data grouping processing.

[0056]

The conditions given by the image sensing data selection designating unit 34 are a correlated color temperature (A(K)) and its selecting range color temperature (±dA(K)). The correlated color temperature range is sometimes directly input by the user as a numerical value. It is also possible to input information related to the correlated color temperature, e.g., words such as "daytime", "evening", "sunset glow", "cloud", and "incandescent lamp", which the user can image in relation to the color temperature. Thus, color temperature ranges corresponding to these words can be previously defined by a system and stored in a memory. A color temperature range corresponding to the information input by the user can be read out and used, or can be obtained by calculations (step S11 in Fig. 6).

It is also possible to use adjectives such as "red" and "pale" from which the color temperatures can be imagined or practical values of chromaticity or a color difference.

[0057]

When the above conditions are designated, the correlated color temperature as the intrinsic information of image sensing data can be designated by using, e.g., a chromaticity diagram shown in Fig. 7.

[0058]

[Equation 1]

Fig. 7 is a graph shown as Appended Figure 1 in JIS Z 8725 "Methods for Determining Distribution Temperature and Color Temperature or Correlated Color Temperature of Light Source". In Fig. 7, T_{cp}^{-1} is a reciprocal correlated color temperature T_{cp}^{-1} (MK^{-1}) and has the following relationship with a correlated color temperature T_{cp}:

$$T_{cp}(K) = 10^6/T_{cp}^{-1}(MK^{-1})$$

[0059]

The above condition is supplied to the image sensing data selecting unit 33 and used as the condition of grouping.

[0060]

The image sensing data selecting unit 33 sequentially loads the image sensing data stored in the image data memory 20 (S12), analyzes the image sensing data and extracts information pertaining to the color temperature (S13), and checks whether the color temperature information satisfies the previously designated grouping condition (S14). If the color temperature information satisfies the condition, the image sensing data selecting unit 33 supplies the corresponding image sensing data to the image sensing data holding unit 31 (S15).

[0061]

[Equation 2]

Generally, the color temperature information obtained by analyzing the image sensing data is not a correlated color temperature itself but another signal having a one-to-one correspondence with the correlated color temperature. For example, when an image sensing device from which an R,G,B signal is obtained is used, it is possible to use, as the signal pertaining to the color temperature information, an (R/G,B/G) signal obtained by averaging image sensing data of one image plane or an (R/G,B/G) signal obtained as an average value of regions (which meet the condition that, e.g., their chromaticity values are within the range which defines the correlated color temperature in Fig. 7) sampled from image sensing data and corresponding to white. An example of the (R/G,B/G) signal is shown in

Fig. 8. Since the (R/G,B/G) signal depends upon the sensitivity characteristic of the image sensing device used with respect to each color component, it is necessary to obtain the correspondence to the correlated color temperature by taking into account the characteristics of an image sensing device used as a system. Since the characteristics of the (R/G,B/G) signals and the correlated color temperatures whose correspondence is thus obtained are in a one-to-one correspondence with each other, the relationship between the correlated color temperature (A(K)) and its selecting range color temperature (±dA(K)) which are the grouping conditions previously given can also be defined as follows by using the (R/G,B/G) signal. That is, the range of the correlated color temperatures of image sensing data to be grouped can be defined as A±dA(k), or $((R/G)_0 \pm d(R/G)_0, (B/G)_0 \pm d(R/G)_0)$. Accordingly, to directly check by using the (R/G,B/G) signal whether the grouping conditions are met, it is only necessary to check whether the color temperature information (R/G, B/G) obtained by analyzing the image sensing data is within the range of $((R/G)_0 \pm d(R/G)_0, (B/G)_0 \pm d(R/G)_0)$. To make this determination by using the correlated color temperature, a correlated color temperature corresponding to the (R/G,B/G) signal directly obtained from the image sensing data is obtained, and whether

this correlated color temperature is within the range of A±dA(K) as the grouping condition is checked. When a condition related to the color temperature information is given as the grouping condition, the above processing is sequentially executed for the image sensing data stored in the image sensing data memory 20. It is determined that image sensing data meeting the condition are image sensing data constituting the group. The image sensing data thus found to constitute the group are supplied to the image sensing data holding unit 31 (S15) and held in it.

[0062]

A method of grouping image sensing data when the composition of an object is designated as the condition of grouping will be described below. Fig.†9 is a flow chart showing the processing.

[0063]

If the composition is designated as the grouping condition, the image sensing data selecting unit 33 loads the image sensing data stored in the image sensing data memory 20 (steps S21 and S22 in Fig. 9). Simplified reproduction is performed to the extent to which the composition is confirmed (S23), thereby obtaining simple reproduced image data. The simplified reproduction can be reproduction processing to the extent to which the composition can be confirmed. For example, pixels are thinned from image sensing data and luminance data is reproduced while the data amount is thus decreased.

[0064]

Subsequently, the determination of grouping is performed by using the simple reproduced image data (S29). However, it is generally efficient to subjectively determine, e.g., the similarity between images. Therefore, this subjective determination method is used in this embodiment of the present invention. That is, if an instruction from the user can be expected in the determination of grouping, a series of simple reproduced image data are displayed on a monitor (S25). A means for allowing the user to select images to be grouped is arranged, and image sensing data corresponding to the images selected by the user are sequentially supplied to the image sensing data holding unit 31 and held in it (S26 and S30).

[0065]

To automatically determine grouping, for example, the following procedure is performed. That is, edge image data is formed by extracting an edge component from simple reproduced image data, and the sameness or the similarity of the spatial relationship between edges is detected by applying an image processing technology (S27 and S28). The spatial correlation obtained by analyzing the sameness or the similarity is checked, and it is determined that images having a strong correlation are images meeting the grouping condition, and then image sensing data corresponding to the images are supplied to the image sensing data holding unit 31 and held in it (S29 and S30).

A method of grouping image sensing data by using information appended to the image sensing data will be described below. Fig. 10 is a flow chart showing an example of the grouping processing.

[0066]

Assume that information appended to image sensing data and the condition of the information are given as the condition of grouping to the image sensing data selection designating unit 34. The image sensing data selecting unit 33 checks whether the information corresponding to the conditions is appended to the image sensing data stored in the image sensing data memory 20, and sequentially loads image sensing data to which the information is appended (steps S31 and S32 in Fig. 10). The image sensing data selecting unit 33 then checks whether the appended information meets the designated condition of selection for grouping (S33 and S34).

[0067]

If information such as the photographing time, the

EV value, the aperture value, the object distance, or the shutter speed whose range can be numerically set is used, the grouping selection condition is whether the value of the appended information falls within the numerically indicated range. If information such as the image sensing mode, the photographing place, the use/nonuse of an electronic flash, or the use/nonuse of an optical low-pass filter which is difficult to numerically indicate is used, the agreement between the names of the places, the names of the modes, or the presence/absence is the condition. If the grouping information (the same mark is given to image sensing data obtained in the continuous shooting mode) depending on the image sensing mode or the grouping information (the same mark is given to image sensing data obtained in the same place) depending on the photographing place is given as appended information, the agreement between the given marks is the condition. Image sensing data meeting the grouping selection condition are sequentially supplied to the image sensing data holding unit 31 (S35 and S36) and held in it.

[0068]

A method of grouping image sensing data when a synthetic image is to be obtained by increasing the dynamic range as disclosed in Japanese Patent Laid-Open

No. 7-131796, for example, or a synthetic image is to be obtained by a method of panorama image synthesis for obtaining a wide-angle image from a plurality of image sensing data as disclosed in Japanese Patent Laid-Open No. 5-183789, for example, will be described below. In a case like this, it is desirable that appended information indicating that data is image sensing data for obtaining a certain synthetic image be given to the data during photography. If this is the case, in this embodiment, image sensing data constituting an image sensing data group are selected and grouped on the basis of the appended information. Alternatively, as explained with respect to the method of grouping the image sensing data using composition information, it is also possible to simply reproduce image sensing data, perform grouping determination, and group the image sensing data. In processing for obtaining synthetic image, all image sensing data stored in the image sensing data memory 20 are in some cases previously selected as image sensing data to be processed as a group when the processing is executed. If this is the case, in the present invention, the image reproduction is performed by processing all of the image sensing data stored in the image data memory 20 as a group of image sensing data.

[0069]

As seen in the above-described embodiment, the gist of the present invention lies in that when image sensing data is to be converted into image data, a plurality of image sensing data meeting a predetermined condition are processed as one group of image sensing data, an image reproduction parameter is obtained from this image sensing data group, and the image sensing data belonging to the image sensing data group is converted into image data by using this image reproduction parameter. Therefore, various types of sequence processings can be considered without departing from the spirit and scope of the present invention as described above. These sequence processing operations are theorized or implemented in software, for example. Alternatively, these sequences are implemented in algorithm to the extent to which the implementation does not depart from the scope and spirit of the present invention, and a hardware apparatus operating in accordance with the algorithm can be applied.

[0070]

[Effects of the invention]

As described above, according to the present invention, a plurality of image sensing data meeting a predetermined condition are processed as one image sensing data group and an image reproduction parameter is determined on the basis of the image sensing data group. Then, the image sensing data belonging to the image sensing data group can be converted into image data by using the image reproduction parameter. Accordingly, the present invention solves the problem which occurred in the conventional image reproduction processing method, i.e., the problem that when an image reproduction parameter is determined from the image sensing data, a condition for determining the parameter is usually dissatisfied and hence the parameter cannot be accurately determined. Therefore, the image sensing data can be converted into image data using a more accurate image reproduction parameter, thus enabling accurate image reproduction. In addition, loss of the correlation between the image sensing data caused by the use of different image reproduction parameters for each of images (image sensing data) upon reproduction processing can be eliminated. The image sensing data can be converted into image data by using a more accurate image reproduction parameter in which the information and correlation between the respective images are held, thus enabling reproduction of natural and accurate images.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a block diagram showing an embodiment of an image reproducing apparatus according to the present invention.

[Fig. 2]

Fig. 2 is a flow chart showing the operation of the embodiment of the present invention.

[Fig. 3]

Fig. 3 is a view for explaining an example of a photographed object in accordance with the embodiment of the present invention.

[Fig. 4]

Fig. 4 is a view for explaining an example of a photographed object in accordance with the embodiment of the present invention.

[Fig. 5]

Fig. 5 is a view for explaining an example of a photographed object in accordance with the embodiment of the present invention.

[Fig. 6]

Fig. 6 is a flow chart showing the operation of the embodiment of the present invention.

[Fig. 7]

Fig. 7 is a view for explaining an image sensing data selection condition given in the embodiment of the present invention.

[Fig. 8]

Fig. 8 is a view for explaining an image sensing data selection condition range used in the embodiment of the present invention.

[Fig. 9]

Fig. 9 is a flow chart showing the operation of the embodiment of the present invention.

[Fig. 10]

Fig. 10 is a flow chart showing the operation of the embodiment of the present invention.

[Description of the Reference Numerals]

10	color image sensing unit (image sensing means)
20	image sensing data memory (memory means)
30	color image reproduction processor
31	image sensing data holding unit
32	image reproduction parameter determining unit (determining means)
33	image sensing data selecting unit
34	image sensing data selection designating unit (designating means)
35	image reproduction processing unit
36	control unit
40	color image reproducing display
50	reproduced image data memory

[Type of the Document] Abstract

[Abstract]

[Object] Desired accurate image reproduction can be performed.

[Structure] An image reproducing apparatus comprises an image sensing data memory 20, an image sensing data selection designating unit 34, an image sensing data selecting unit 33 for selecting image sensing data from the image sensing data memory 20, an image sensing data holding unit 31 for holding the image sensing data selected by the image sensing data selecting unit 33, an image reproduction parameter determining unit 32 for determining an image reproduction parameter by using the selected and held image sensing data, and an image reproduction processing unit 35 for performing image reproduction of the image sensing data held by the image sensing data holding unit 31 by using the image reproduction parameter determined by the image reproduction parameter determining unit 32.

[Selected Drawing] Fig. 1

7-196677

TYPE OF DOCUMENT
【書類名】 図面 DRAWINGS

【図１】 [FIG. 1]

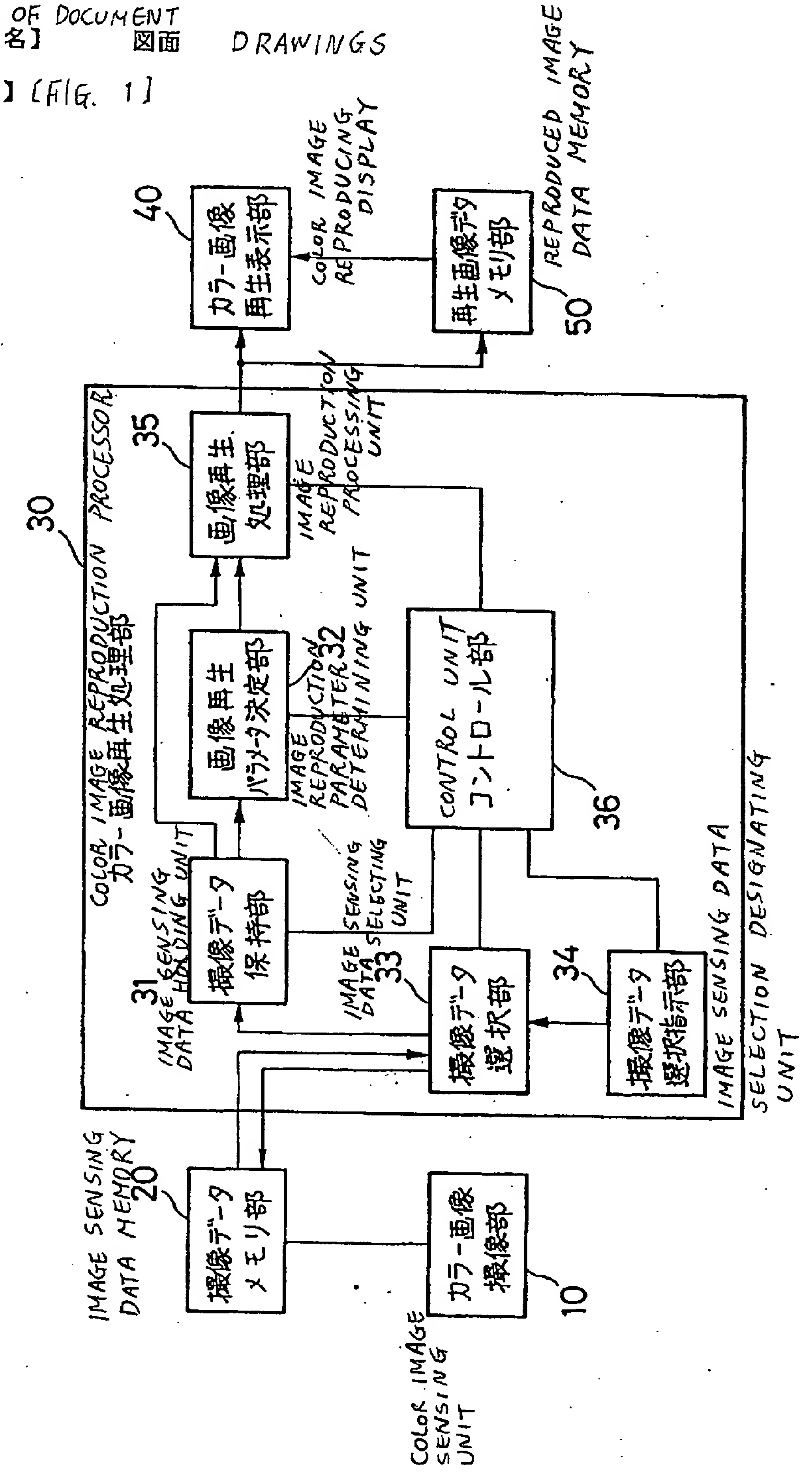

40
カラー画像再生表示部
COLOR IMAGE REPRODUCING DISPLAY
50
再生画像データメモリ部
REPRODUCED IMAGE DATA MEMORY
30
カラー画像再生処理部
COLOR IMAGE REPRODUCTION PROCESSOR
35
画像再生処理部
IMAGE REPRODUCTION PROCESSING UNIT
32
画像再生パラメータ決定部
IMAGE REPRODUCTION PARAMETER DETERMINING UNIT
36
CONTROL UNIT
コントロール部
31
撮像データ保持部
IMAGE SENSING DATA HOLDING UNIT
33
撮像データ選択部
IMAGE SENSING DATA SELECTING UNIT
34
撮像データ選択指示部
IMAGE SENSING DATA SELECTION DESIGNATING UNIT
20
撮像データメモリ部
IMAGE SENSING DATA MEMORY
10
カラー画像撮像部
COLOR IMAGE SENSING UNIT

FIG. 2
【図２】

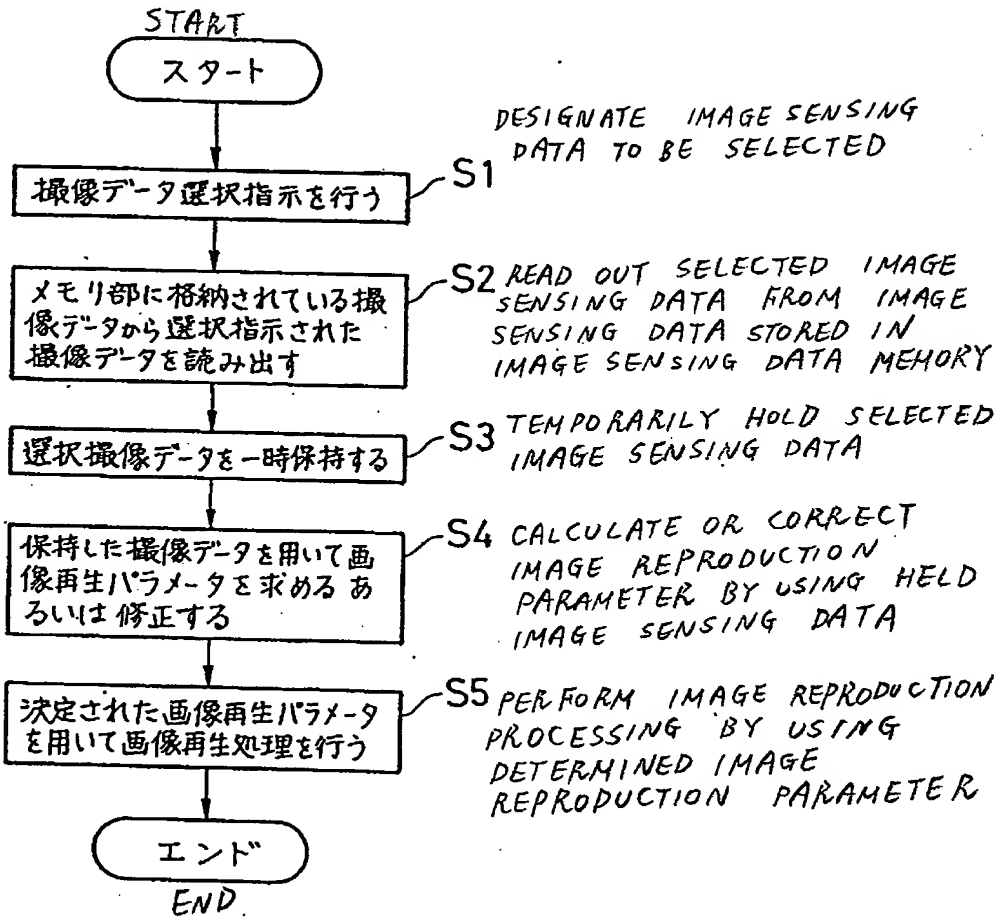
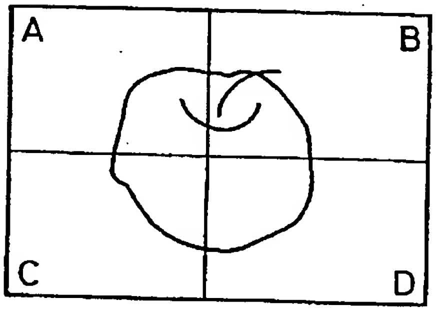
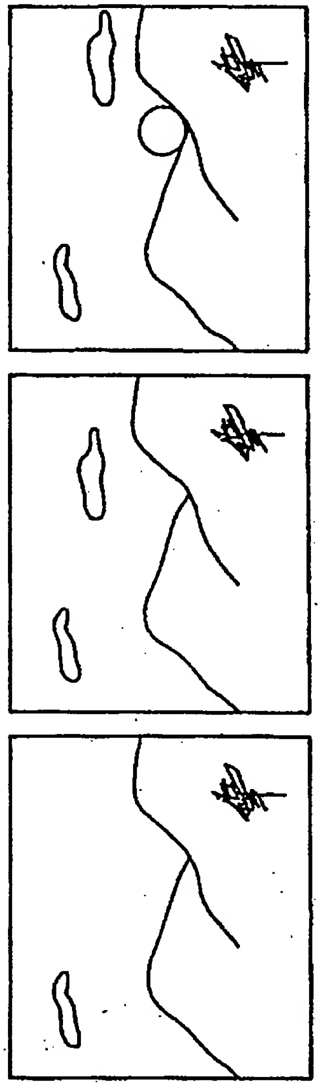

START
スタート
S1
撮像データ選択指示を行う
DESIGNATE IMAGE SENSING DATA TO BE SELECTED
S2
メモリ部に格納されている撮像データから選択指示された撮像データを読み出す
READ OUT SELECTED IMAGE SENSING DATA FROM IMAGE SENSING DATA STORED IN IMAGE SENSING DATA MEMORY
S3
選択撮像データを一時保持する
TEMPORARILY HOLD SELECTED IMAGE SENSING DATA
S4
保持した撮像データを用いて画像再生パラメータを求める あるいは修正する
CALCULATE OR CORRECT IMAGE REPRODUCTION PARAMETER BY USING HELD IMAGE SENSING DATA
S5
決定された画像再生パラメータを用いて画像再生処理を行う
PERFORM IMAGE REPRODUCTION PROCESSING BY USING DETERMINED IMAGE REPRODUCTION PARAMETER
エンド
END

FIG. 3
【図３】



【図４】 FIG.4



【図５】 FIG. 5

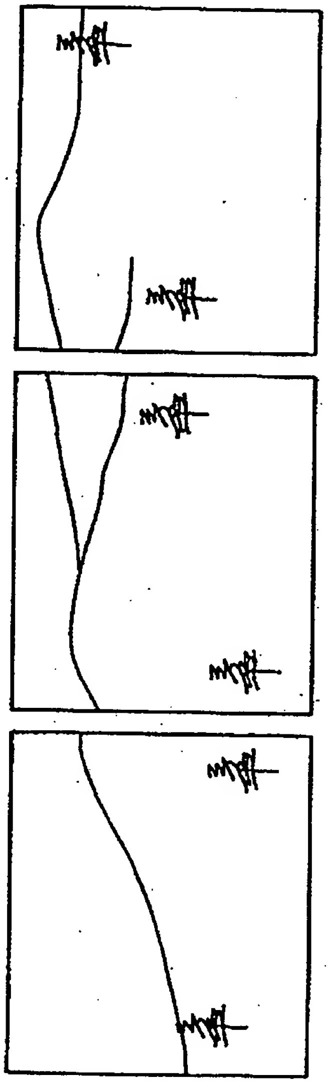
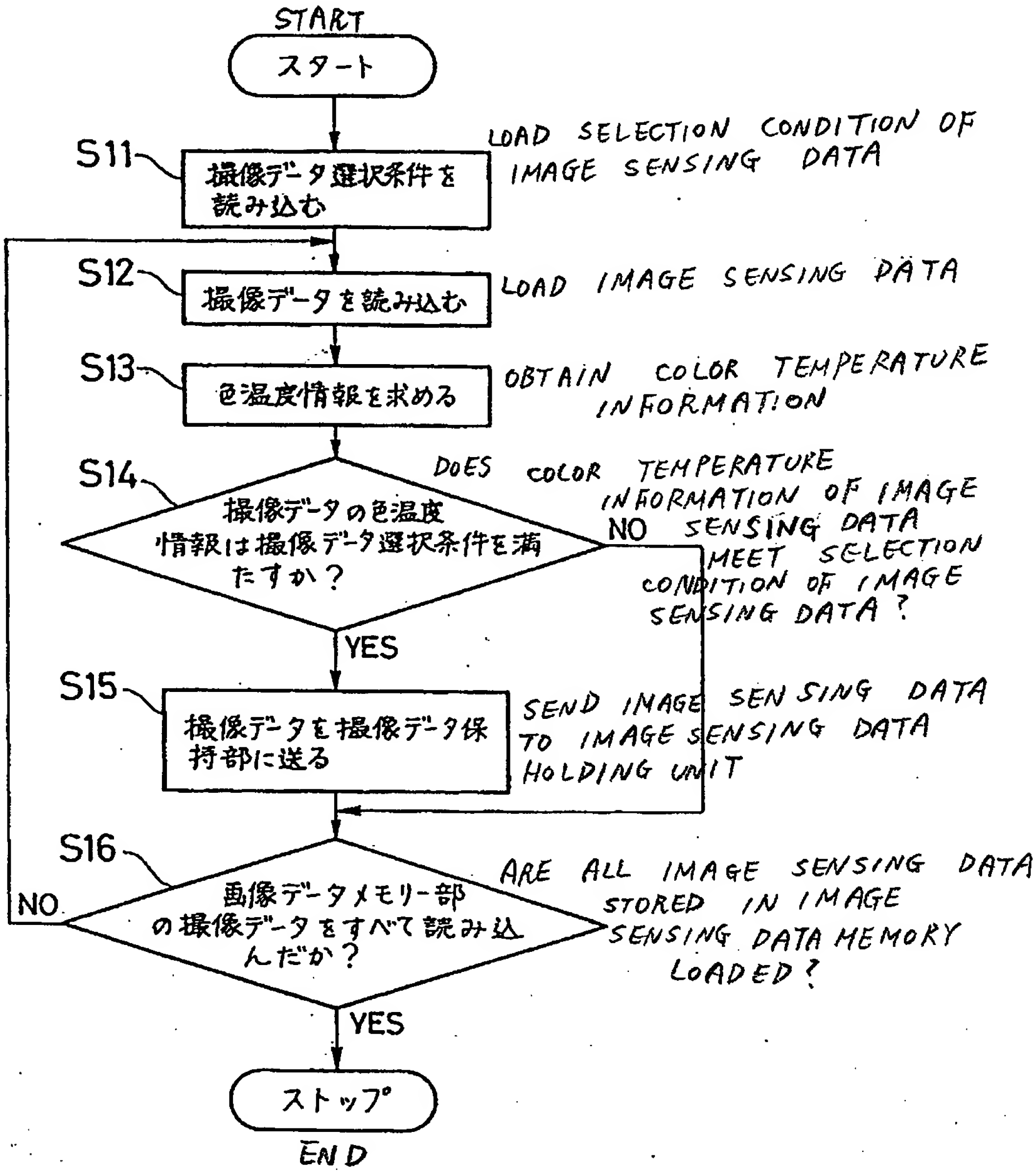
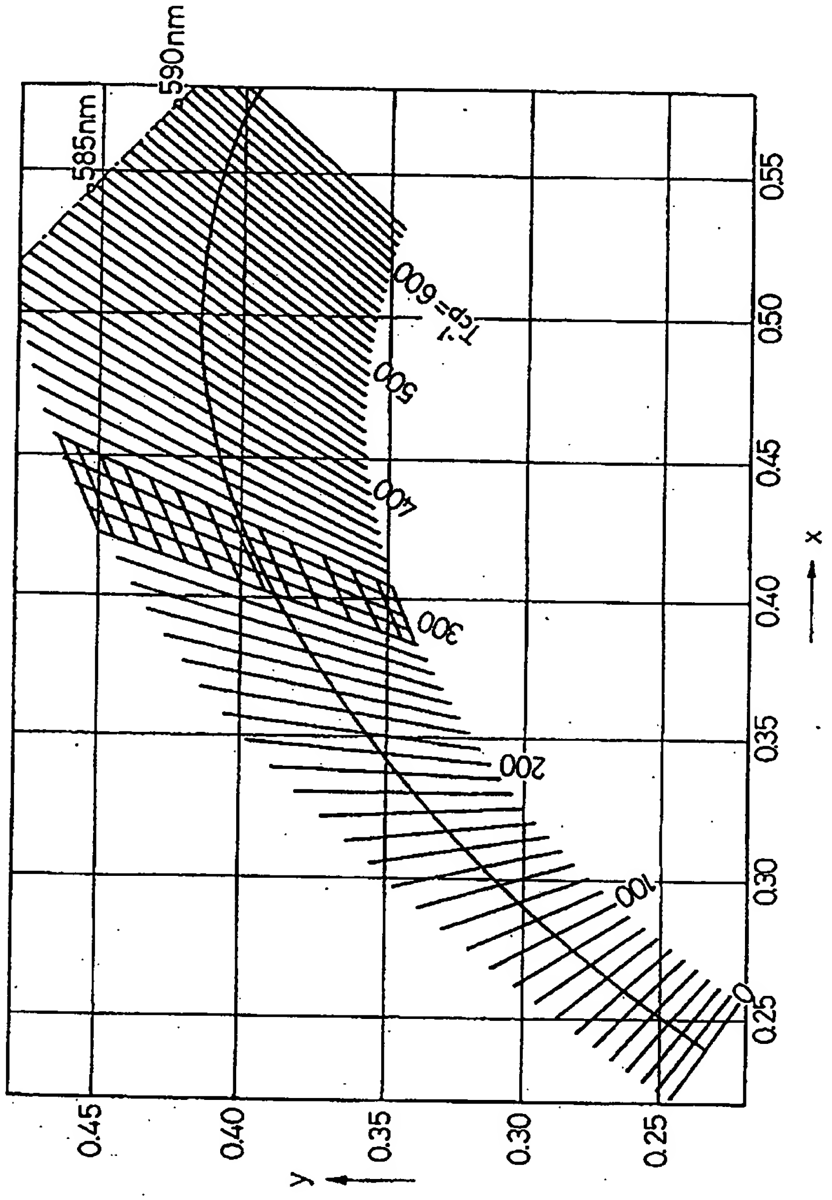


FIG. 6

【図６】


START
スタート
S11
撮像データ選択条件を読み込む
LOAD SELECTION CONDITION OF IMAGE SENSING DATA
S12
撮像データを読み込む
LOAD IMAGE SENSING DATA
S13
色温度情報を求める
OBTAIN COLOR TEMPERATURE INFORMATION
S14
撮像データの色温度情報は撮像データ選択条件を満たすか？
DOES COLOR TEMPERATURE INFORMATION OF IMAGE SENSING DATA MEET SELECTION CONDITION OF IMAGE SENSING DATA ?
NO
YES
S15
撮像データを撮像データ保持部に送る
SEND IMAGE SENSING DATA TO IMAGE SENSING DATA HOLDING UNIT
S16
画像データメモリー部の撮像データをすべて読み込んだか？
ARE ALL IMAGE SENSING DATA STORED IN IMAGE SENSING DATA MEMORY LOADED ?
NO
YES
ストップ
END

【図7】 FIG.7


590nm
585nm
Tcp=600
500
400
300
200
100
0
0.55
0.50
0.45
0.40
0.35
0.30
0.25
x
0.45
0.40
0.35
0.30
0.25
y

【図８】 FIG.8

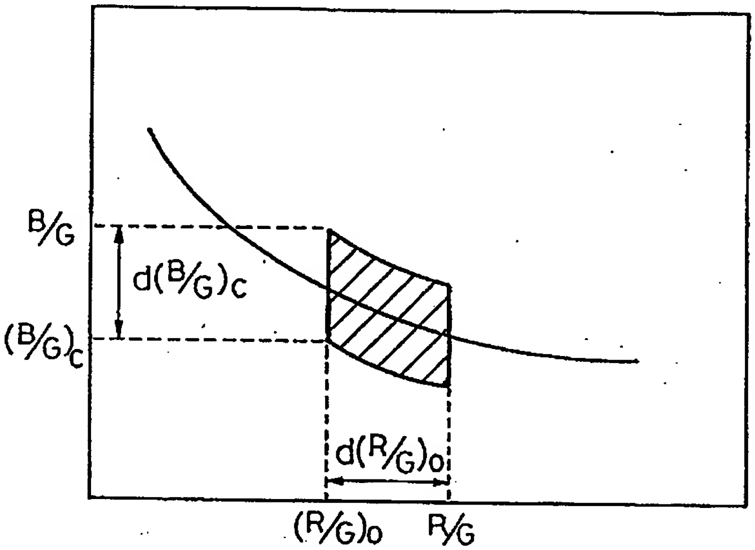
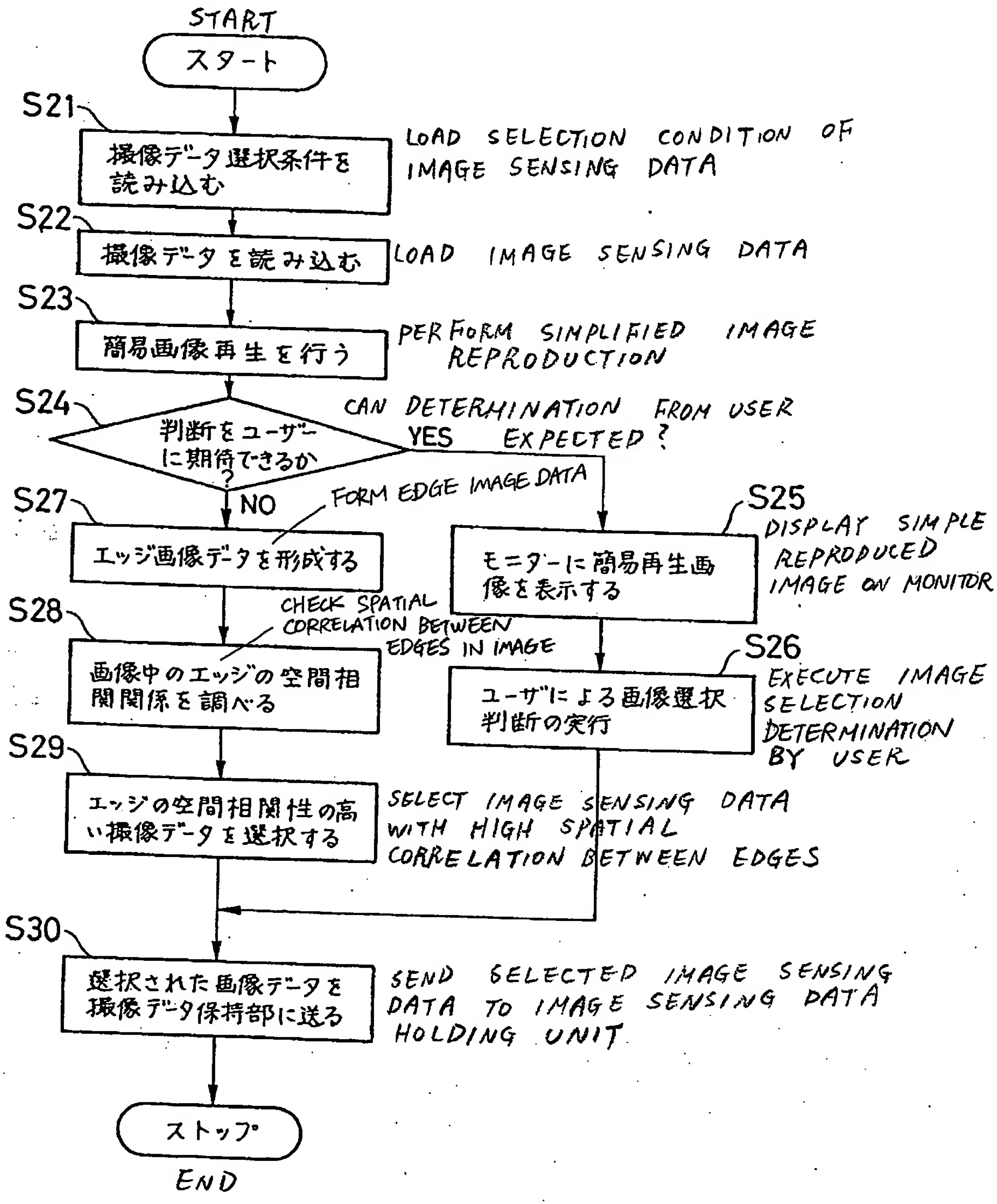
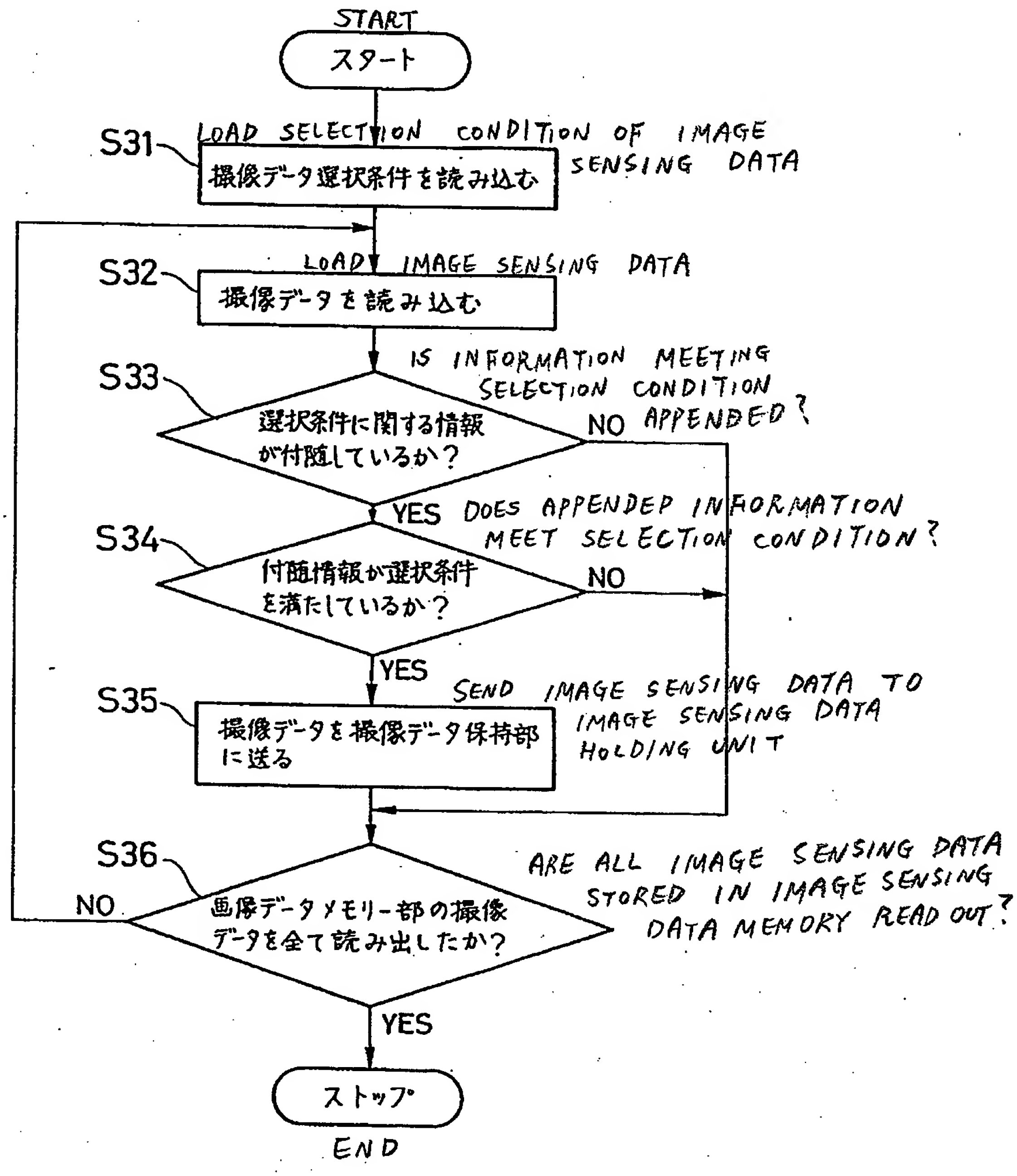


FIG. 9
【図９】


START
スタート
S21
撮像データ選択条件を読み込む
LOAD SELECTION CONDITION OF IMAGE SENSING DATA
S22
撮像データを読み込む
LOAD IMAGE SENSING DATA
S23
簡易画像再生を行う
PERFORM SIMPLIFIED IMAGE REPRODUCTION
S24
判断をユーザーに期待できるか？
CAN DETERMINATION FROM USER EXPECTED ?
YES
NO
S27
エッジ画像データを形成する
FORM EDGE IMAGE DATA
S28
画像中のエッジの空間相関関係を調べる
CHECK SPATIAL CORRELATION BETWEEN EDGES IN IMAGE
S29
エッジの空間相関性の高い撮像データを選択する
SELECT IMAGE SENSING DATA WITH HIGH SPATIAL CORRELATION BETWEEN EDGES
S25
モニターに簡易再生画像を表示する
DISPLAY SIMPLE REPRODUCED IMAGE ON MONITOR
S26
ユーザによる画像選択判断の実行
EXECUTE IMAGE SELECTION DETERMINATION BY USER
S30
選択された画像データを撮像データ保持部に送る
SEND SELECTED IMAGE SENSING DATA TO IMAGE SENSING DATA HOLDING UNIT
ストップ
END

【図１０】 FIG. 10


START
スタート
S31
LOAD SELECTION CONDITION OF IMAGE SENSING DATA
撮像データ選択条件を読み込む
S32
LOAD IMAGE SENSING DATA
撮像データを読み込む
S33
IS INFORMATION MEETING SELECTION CONDITION APPENDED?
選択条件に関する情報が付随しているか？
NO
YES
S34
DOES APPENDED INFORMATION MEET SELECTION CONDITION?
付随情報が選択条件を満たしているか？
NO
YES
S35
SEND IMAGE SENSING DATA TO IMAGE SENSING DATA HOLDING UNIT
撮像データを撮像データ保持部に送る
S36
ARE ALL IMAGE SENSING DATA STORED IN IMAGE SENSING DATA MEMORY READ OUT?
画像データメモリー部の撮像データを全て読み出したか？
NO
YES
ストップ
END